L10 ANSWER 1 OF 2 PAPERCHEM2 COPYRIGHT 2002 ELSEVIER ENGINEERING INFORMATION INC.

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TI FRICTION ELEMENTS AND METHODS OF THEIR MANUFACTURE

IN Borg-Warner Corp.

PI **GB 1078773** 19670809

SO p. 6. 9 claims..

DT Patent

FS PAPERCHEM

LA English

AB A process for making a porous friction matl. suitable for forming a facing for a wet clutch comprises mixing asbestos fibers with a binder soln. and a friction-enhancing matl., evapg. the sovlent, and curing the binder. The binder can be a soln. of a phenolic resin in ethanol, and the friction-enhancing matl. can be barytes.

CT ADHESIVES; ASBESTOS; BINDERS; CLUTCHES; DRIVES; FACINGS; FIBERS; FRICTION DRIVES; INORGANIC FIBERS; MECHANICAL DRIVES; MINERAL FIBERS; SILICATES; SILICON COMPOUNDS; GREAT BRITAIN; ENGLISH; PATENTS

L10 ANSWER 2 OF 2 WPIDS (C) 2002 THOMSON DERWENT

AN 1968-88709P [00] WPIDS

TI Friction material with resin binder.

DC A00

PA (BORW) BORG WARNER CORP

CYC 1

PI GB 1078773 A (196800)* <--

PRAI US 1963-311108 19630924; US 1967-689237 19671124

AB GB 1078773 A UPAB: 19930831

Friction material, of porous type such as for wet clutches or brakes in power transmissions, is made from a pasty mixt. of asbestos fibre with nut shell resin, etc., and with a binder soln. of uncured resin in a low-boiling-point solvent such as ethyl alcohol, the solvent being then evaporated and the resin cured. The resultant material has interconnected pores occupying at least 35% of its volume.

The binder is pref. an oil-modified phenolic resin, and the friction-enhancing material is pref. barytes and/or polymerised cashew nut shell resin.

FS CPI

FA AB

MC CPI: A05-C; A12-A; A12-T04

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PATENT SPECIFICATION

DRAWINGS ATTACHED

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Date of Application and filing Complete Specification: Sept. 15, 1964.

No. 37695/64.

Application made in United States of America No. (311108) on Sept. 24, 1963.

Complete Specification Published: Aug. 9, 1967.

Index at acceptance: —C3 C1X; B2 K(2B, 2Y, 3D, 4X, 6A, 6C, 7A3, 7AY, 8D, 8X, 9E, 8J, 8Q8, 9QX, 9QY); C3 N(3A2A, 3B1C, 3B9A, 3C); C3 R(1A, 1C, 1C5, 1C6, 1C8, 1G); D2 B(1, 11A, 13A, 13F, 13JX)

Int. Cl.: —C 08 j 1/14//B 05 c, C 08 g, h, C 09 k, D 21 h

COMPLETE SPECIFICATION

Friction Elements and Methods of their Manufacture

We, BORG-WARNER CORPORATION, a Corporation organised and existing under the laws of the State of Illinois, United States of America, of 200 South Michigan Avenue, Chicago 4, Cook County, Illinois, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the production of porous friction material, to material so produced, and to friction members having a facing of such material.

Torque control devices such as clutches and brakes which run continuously in a bath of oil or other fluid require friction materials having special properties to achieve optimum performance. Of primary importance is the requirement that such friction materials have interconnected porosity to promote the absorption of the oil deep into the interstices of the material. When the clutch is engaged and the friction facing is brought into contact with the driving (or driven member), the oil film carried on the facing must be removed by squeezing the oil into the material. Otherwise, the initial coefficient of friction is undesirably low.

One of the more commonly used wet clutch friction materials is a so-called "paper" lining or facing. This paper material is manufactured by saturating a cellulose fibre mat containing various fillers, such as diatomaceous earth and glass fibres, with a resin binder solution and then curing the resin binder. It is well known that cellulose fibres tend to break down at elevated temperatures (approximately 350°F.), so that friction materials prepared therefrom are not suitable for certain applications involving high temperature operation, such as in heavy duty transmissions and the like. Moreover, the process for manufacturing and applying the paper facing material to the backing or reinforcing members involves a substantial number of manufacturing operations and produces a considerable amount of scrap material which cannot be economically salvaged.

In one aspect, this invention consists in a process for making a porous friction material suitable for forming a facing for a wet type clutch, comprising the steps of mixing asbestos fibres with sufficient of a friction-enhancing material and of a binder solution comprising an uncured resin dissolved in a low boiling solvent, to provide a mixture having a pasty consistency, evaporating the solvent to transform the material into a porous mass, and curing the uncured resin in the material, the relative proportions of the constituents of the mixture being such that the product has an interconnected void content of at least 35% by volume, and preferably 40—65% by volume.

The invention comprises also the formation of friction members having a facing of such material, as well as the material and friction members themselves.

The invention is illustrated by the accompanying Drawing, in which the several Figures are flow sheets illustrating different ways in which the invention can be applied,

FIGURE 1 illustrating a preferred embodiment of the invention,

FIGURE 2 a modification of this embodiment, and

FIGURE 3 another modification thereof.

The Drawing will be further referred to in the Examples.

Various friction-enhancing materials are

known, and can be used in the process of the invention, barytes (naturally occuring barium sulphate), granules of polymerised cashew nut shell resin, or a mixture of both, being particularly preferred. The binder preferably comprises a thermosetting resin, especially an oil-modified phenolic resin. As solvent ethyl alcohol can be used with advantages and is cheap, but other well known volatile solvents can replace it wholly or in part. The particular grade of asbestos used is important, and the fibres should not be excessively long or short; the longest asbestos fibres tend to give linings which are too low in density and wear too fast, but if the fibres are too short the linings may be too dense and may not have the required porosity. Suitable commercial grades are well known and can be selected without any difficulty.

In a preferred method of making the friction material the asbestos fibres and the friction-enhancing material are first mixed together, after which they are further mixed with the binder solution. The resulting pasty mixture will then usually be coated on a member which is to carry the friction facing, after which the solvent is evaporated and the product heated to cure the resin binder. The member to be faced will usually be primed in a manner known per se to cause the facing to adhere firmly to it. (Suitable adhesives for this purpose are well known, and include varnish-type phenolic resins and the more flexible modified phenolic resins. When resistance to damage by bending is not important, a straight phenolin resin can be used). However, other methods of applying the invention are described below.

In a particularly valuable application of the invention, illustrated in Figure 1 of the Drawing, the paste is coated onto an adhesive primed metal backing plate or element which constitutes one of the driving and/or driven members of the clutch mechanism. The coated plate is thereafter dried to remove the solvent and render the material porous, placed in a curing environment, and finished by grinding or some equivalent method.

This process, hereinafter referred to as the coating process, has the advantages of (1) requiring a minimum number of process steps, (2) producing the least waste or scrap, and (3) being the best adapted for continuous process production techniques. It is illustrated in Example I. (In the Examples all parts are by weight).

EXAMPLE I

A paste was made up having the following composition:

Chrysotile asbestos (7D—1)[1]	64 parts
Barytes	10 parts
Resin granules[2]	10 parts
Binder solution[3]	60 parts
Solvent (essentially ethyl alcohol)	142 parts

[1] Canadian Standard Screen Analysis

[2] A cashew nut shell resin known as "Collan 10A (Approximately 20 mesh)

[3] A varnish-type phenolic resin (50% solids).

The dry components comprising asbestos, barytes and the cashew nut shell resin were mixed thoroughly for about ten minutes to provide a uniform mixture, and to break up the asbestos lumps. The binder solution, after being thinned with the solvent and mixed, was then added to the dry mixture, and mixing was continued for approximately one hour, giving a stiff mixture of uniform composition. The larger cashew nut shell resin granules showed no tendency to settle out, even after long standing. It was found desirable to mix the ingredients in a closed container to minimise solvent evaporation during the mixing period.

The metal backing plates, of the type used in a conventional multiple disc clutch, were provided with a suitable adhesive and then coated with the stiff, dough-like mixture to provide a coating approximately 0.050 inches thick on both sides of each plate. This coating procedure may be performed in a fixture or mould which is preferably coated with a silicone grease or other releasing agent to prevent adhesion of the coating composition thereto. Each plate was coated, one side at a time, by distributing about 14 g. of the coating mixture over the surface of the plate, tamping the dough-like mixture to eliminate any air pockets, and then smoothing the surface with an appropriate implement to eliminate any unevenness left after the tamping.

The solvent was evaporated by heating the coated plate at a temperature of approximately 130°F. for three hours. While there was some evidence of shrinkage of the coating during the drying cycle, it did not occur in a direction parallel to the lining surface and was therefore of no consequence.

The coated plates are preferably removed from the coating fixture prior to being placed

in a curing oven. In this Example, the coated plates were supported in such a way that the supports engaged an uncoated portion thereof, and the plates were cured in an oven for approximately one-half hour at a temperature of 360°—370°F.

The cured lining had a rather rough surface as a result of the evaporation of the solvent from the mixture. Since it is necessary that the surfaces of a clutch plate be flat and parallel for optimum performance, the cured plates were finished by grinding to the required total thickness (approximately 0.100").

The process illustrated in Figure 2 differs from the coating process described above in that the paste or dough-like mixture is rolled out or calendered into thin sheets of relatively uniform thickness, which are dried and cut into pieces of the appropriate size and shape; these are then bonded to the backing plates as before, and cured and finished. It will be noted that this process requires a scrap recovery step after the material is cut into the appropriate form for bonding to the backing plates.

Example II

The process of Example I was repeated, except that the paste, instead of being applied directly to the backing members, was rolled out into a sheet 0.05 inches thick, which was dried at 130°F. for 3 hours and then applied to the primed backing. This assembly was cured and ground as before.

Example III

This Example illustrates the process shown in Figure 3, which for convenience is referred to as the "felted lining" process.

The following recipe was employed:

Chrysotile asbestos (7D—1) — 1/2 passed 8 mesh screen	19 parts
Barytes	3 parts
Resin (Collan 10A) 20 mesh granules	3 parts
Binder solution (Varnish-type phenolic resin (50% solids)).	144 parts
Solvent (essentially ethyl alcohol)	72 parts
Xylene	144 parts

The dry ingredients, namely the asbestos, barytes, and Collan 10A resin granules were dry mixed at slow speeds in a laboratory mixer. The binder solution was thinned with solvent and xylene and added to the dry ingredients, and the whole was mixed to form a slurry having the consistency of thick cream. It was noted that the speed of the mixer and the length of the mixing time were rather important, since too vigorous mixing broke up the asbestos fibre bundles and increased the number of fine particles in the mixture, while in too mildly stirred mixtures the longer fibres tended to ball up and rope. The use of more solvent assists in providing a more uniform mixture but this advantage must be balanced against increased material segregation in the thinner mixtures.

After mixing, the mixture was poured into a felting medium which, in the Example, was a vacuum filter. The slurry was evenly distributed by oscillating and shaking the filter back and forth, while a vacuum of approximately 2 inches of mercury was applied to draw the solvent and resin solution through the filter and "felt" the friction composition onto the filter face. The resulting felted composition was then dried at room temperature to minimise resin migration. After removal from the felting medium, the dried material was flexible and plastically deformable like a stiff dough. The lining discs were then cut from the air dried composition and lightly coated with the resin solution on the side to be bonded. The scrap material from the cutting process may be resaturated in alcohol and used again, because the resin, at this stage, is still uncured.

The discs were then applied to an adhesive primed base plate as before, and were carefully pressed into contact to ensure a good bond. Thereafter, the assemblies were oven cured without pressure for approximately 3/4 hour at 360°—37°F. After curing the elements were finish ground to the desired thickness as described in Example I.

In the products of each of the Examples the facing was capable of completely absorbing a drop of oil in 3—15 seconds, indicating that it had a suitable content of interconnecting voids. Materials having void contents above 65% by volume tend to be weak and to tear in heavy duty service.

Each of the above processes as illustrated in the several Examples has individual advantages and drawbacks which may render one process more applicable than another in a particular situation. The felted lining process, which distributes the fibres more randomly than the coated lining processes, gives a somewhat stronger lining and is better adapted for close control of the porosity. On the other hand, the extra bonding and scrap recovery steps make it somewhat less economical than the coated lining process. In any event, it can be seen that the invention provides an improved friction material which is especially adapted for mass production techniques and which is more stable at high temperatures than the cellulosic or "paper" wet clutch linings so commonly used heretofore.

WHAT WE CLAIM IS:—

1. A process for making a porous friction material suitable for forming a facing for a wet type clutch, comprising the steps of mixing asbestos fibres with sufficient of a friction-enhancing material and of a binder solution comprising an uncured resin dissolved in a low boiling point solvent to provide a material

having a pasty consistency, evaporating the solvent to transform the material into a porous mass, and curing the uncured resin in the material, the relative proportions of the constituents of the mixture being such that the product has an interconnected void content of at least 35% by volume.

2. A process as defined in claim 1, wherein the proportions of the constituents are such that the product has an interconnected void content between 40% and 65% by volume.

3. A process as defined in claim 1 or 2, wherein the solvent is ethyl alcohol and is evaporated by heating the material at a temperature of 130°F. for 3 hours.

4. A process as defined in any one of the preceding claims, wherein the binder comprises an oil-modified phenolic resin.

5. A process as defined in any one of the preceding claims wherein the friction-enhancing material is barytes, polymerised cashew nut shell resin, or both.

6. A process as defined in any one of the preceding claims, wherein the uncured, undried pasty material is applied to the surface of an adhesive-primed metal reinforcing member, the solvent is evaporated, and the assembly is treated to cure the resin.

7. A process as defined in any one of claims 1—5, in which the pasty material is formed into a thin sheet and then dried, and the resulting porous sheet is cut to a desired size and laminated with an adhesive-primed reinforcing member, after which the assembly is treated to cure the resin.

8. A process for making a porous friction material according to claim 1 substantially as hereinbefore described.

9. Friction materials obtained by a process claimed in any one of claims 1—5 and 8, and faced friction members obtained by a process claimed in claim 6, 7 or 8.

J. A. KEMP & CO.,
Chartered Patent Agents,
14 South Square,
Gray's Inn, London, W.C.1.

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1078773 COMPLETE SPECIFICATION
1 SHEET This drawing is a reproduction of the Original on a reduced scale

Fig. 2

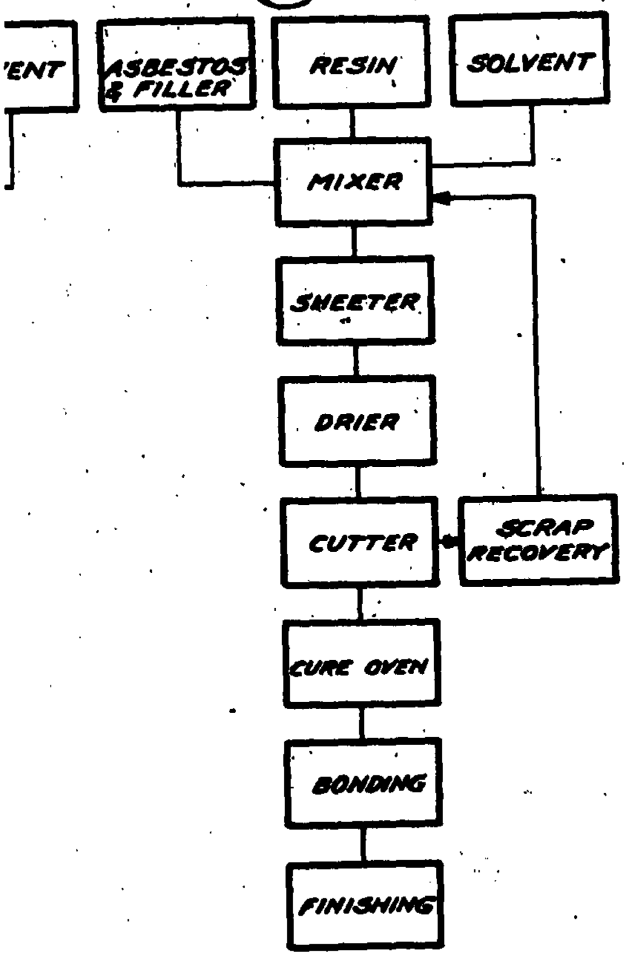


Fig. 3

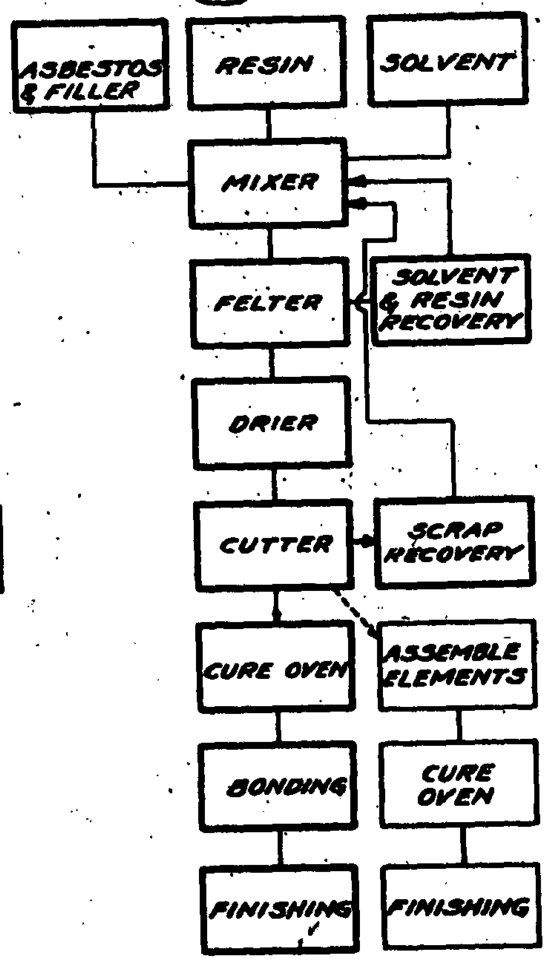


Fig.1

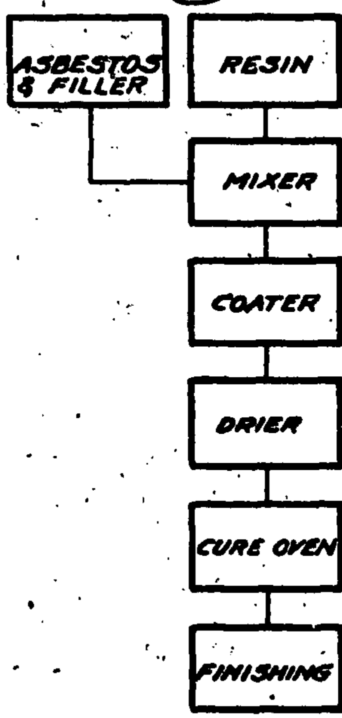
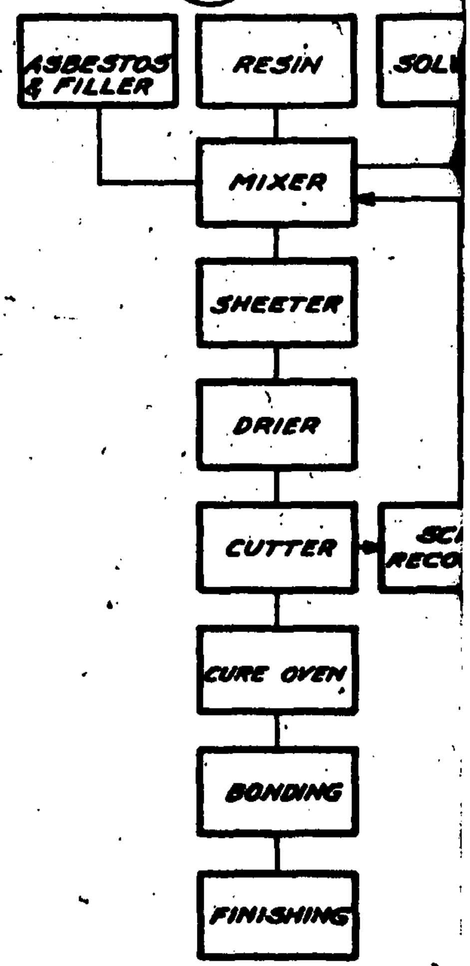

ASBESTOS & FILLER
RESIN
SOLVENT
MIXER
COATER
DRIER
CURE OVEN
FINISHING

Fig.2


ASBESTOS & FILLER
RESIN
MIXER
SHEETER
DRIER
CUTTER
CURE OVEN
BONDING
FINISHING